NASA TECH BRIEF

(GERT EXCLUSIVE-OR) Program for Combining Paths and Loops of Electrical Networks

The problem:

To develop a procedure for analyzing GERT networks containing only EXCLUSIVE-OR nodes.

The solution:

The GERT EXCLUSIVE-OR program takes a network with multiparameter branches and reduces it to a network which has only a single branch connecting source nodes to sink nodes. The program calculates probability, the expected time and the variance in the time to go from each source node to each sink node of the GERT network.

How it's done:

The GERT EXCLUSIVE-OR program determines the paths and loops associated with the network and combines the values associated with paths and loops according to a topology equation to obtain the parameters associated with the equivalent branch from the source node to the sink node. The program determines the source nodes, the sink nodes, the paths connecting the source nodes to the sink nodes, and the loops of the network. The standard output from the program includes: (1) appropriate problem identification headings; (2) the paths and loops of a network; (3) the probability of realizing a sink node from any source node; and (4) the mean and variance of the time to realize a sink node, given that the sink node is realized and given an initial source node. The option exists to delete the loop and/or path output for large or complex networks if it is so desired. The exercising of this option can be beneficial on machines having relatively slow printers or on high speed printers where the standard operating practice is to have a relatively low print limit.

Input to the program includes appropriate problem identification information and the branches of the network. Information concerning each branch includes the start node and end node for the branch, the probability of realizing the branch, and data about the moment generating function of the random variable associated with the branch. The moment generating function (MGF) is described by a three-letter code and up to two parameters of the MGF. The program determines all paths and loops of the network based on the input information. The desired output statistics are computed using the values associated with the loops and paths of the network.

The starting point for the GERT program is the main program, but the only program exit point is in subroutine INPUT. An EXIT occurs when a negative value is obtained in field 1 of a data card. The first error message indicated is one that says that a bad input code was detected in the input data. The entire input network will be read in, but due to the error, the network will not be analyzed. The next network is then considered. The second error message is printed if the number of entries in the dimensioned variable LOOP exceeds the size of LOOP.

The values associated with the loops and paths of the network to obtain the desired output statistics are: (1) the probability; (2) the mean time; and (3) the second moment of the time. The probability associated with the loop or path is the product of the probabilities of the branches comprising the loop or path. The expected time to traverse a loop or path is the sum of the expected times of the branches of the loop or path. The values associated with each loop or path are combined through a topology equation to obtain

the equivalent w-function between the two nodes of interest for a given path. If there is more than one path, the w-functions associated with each path would be summed.

Notes:

1. This program is written in Fortran IV language for use on the IBM-1130 machine. There is another version in Fortran II for use on the GE-225.

2. The program is limited in that the number of nodes which can be accommodated by the program is dependent upon the storage capacity of the machine being used. The present version is dimensioned to permit a network with 100 nodes to be analyzed. The program assumes that the machine used has only 8000 words of core storage.

3. Inquiries concerning this innovation may be directed to:

   COSMIC
   Computer Center
   University of Georgia
   Athens, Georgia 30601
   Reference: B68-10435

Patent status:

No patent action is contemplated by NASA.

Source: A. Alan, B. Pritsker
of Arizona State University
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